ENVIRONMENTAL PROTECTION AGENCY

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July 6, 1988

Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes

ACTION: Regulatory determination.

SUMMARY: Section 3001(b)(2)(B) of the Resource Conservation and Recovery Act (RCRA) requires the Administrator to determine whether to promulgate regulations under RCRA Subtitle C for wastes from the exploration, development, and production of crude oil, natural gas, and geothermal energy. The Adminstrator must make this determination no later than six months after completing a Report to Congress on these wastes and after providing an opportunity for public comment. The Agency has completed these activities and has decided that regulation under RCRA Subtitle C is not warranted. Rather, EPA will implement a three-pronged strategy to address the diverse environmental and programmatic issues posed by these wastes by: (1) Improving Federal programs under existing authorities in Subtitle D of RCRA, the Clean Water Act, and Safe Drinking Water Act; (2) working with States to encourage changes in their regulations and enforcement to improve some programs; and (3) working with Congress to develop any additional statutory authorities that may be required.

FOR FURTHER INFORMATION CONTACT: For further information on the regulatory determination, contact the RCRA/Superfund hotline at (800) 424-9346 (toll free) or (202) 382-3000.

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I. Summary

This action presents the Agency's regulatory determination required by section 3001(b)(2)(B) of the Resource Conservation and Recovery Act (RCRA) for drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy. RCRA requires the Administrator to determine either to promulgate regulations under Subtitle C for wastes from oil, gas, and geothermal exploration, development, and production, or that such regulations are unwarranted. In making this determination, the Administrator is required to utilize information developed and accumulated by the Agency pursuant to a study required under RCRA section 8002(m). The Agency completed this study and published its results in December, 1987 in a Report to Congress entitled "Management of Wastes from the Exploration, Development, and

Production of Crude Oil, Natural Gas, and Geothermal Energy."

In completing the Report to Congress and this determination, EPA gathered and evaluated information on all of the issues raised in section 8002(m), including three key factors pertaining to wastes from the exploration, development, and production of oil, gas, and geothermal energy: (1) The characteristics, management practices, and resulting impacts of these wastes on human health and the environment; (2) the adequacy of existing State and Federal regulatory programs; and (3) the economic impacts of any additional regulatory controls on industry.

In considering the first factor, EPA found that a wide variety of management practices are utilized for these wastes, and that many alternatives to these current practices are not feasible or applicable at individual sites. EPA found that oil, gas, and geothermal wastes originate in very diverse ecologic settings and contain a wide variety of hazardous constituents. EPA documented 62 damage cases resulting from the management of these wastes, but found that many of these were in violation of existing State and Federal requirements.

As to the second factor, EPA found that existing State and Federal regulations are generally adequate to control the management of oil and gas wastes. Certain regulatory gaps do exist, however, and enforcement of existing regulations in some States is inadequate. For example, some States have insufficient controls on the use of landfarming, roadspreading, pit construction and surface water discharge practices. Some States lack sufficient controls for central disposal and treatment facilities and for associated wastes. n1 The existing Federal standards under Subtitle D of RCRA provide general environmental performance standards for disposal of solid wastes, including oil, gas, and geothermal wastes, but these standards do not fully address the specific concerns posed by oil and gas wastes. Nevertheless, EPA has authority under Subtitle D to promulgate more tailored criteria. In addition, the authorities available under the Clean Water Act (CWA) or Safe Drinking Water Act (SDWA) can be more broadly utilized, and efforts are already underway to fill gaps under these programs.

n 1 Associated wastes are those wastes other than produced water, drilling muds and cutting, and rigwash that are intrinsic to exploration, development and production of crude oil and natural gas. See Section II D below.

EPA's review of the third factor found that imposition of Subtitle C regulations for all oil and gas wastes could subject billions of barrels of waste to regulation under Subtitle C as hazardous wastes and would cause a severe economic impact on the industry and on oil and gas production in the U.S. Additionally, because a large part of these wastes is managed in off-site commercial facilities, removal of the exemption could cause

severe short-term strains on the capacity of Subtitle C Treatment, Storage, and Disposal Facilities (TSDFs), and a significant increase in the Subtitle C permitting
burden for State and Federal hazardous waste programs.

As explained in more detail in Section IV of this notice, EPA found that regulation under Subtitle C presents several serious problems. First, Subtitle C contains an unusually large number of highly detailed statutory requirements. It offers little flexibility to take into account the varying geological, climatological, geographic, and other differences characteristic of oil and gas drilling and production sites across the country. At the same time, it does not provide the Agency with the flexibility to consider costs when applying these requirements to oil and gas wastes. **[Page 25447]** Consequently, EPA would not be able to craft a regulatory program to reduce or eliminate the serious economic impacts that it has predicted. Furthermore, since existing State and Federal programs already control oil and gas wastes in many waste management scenarios, EPA needs to impose only a limited number of additional controls targeted to fill the gaps in the existing programs. Subtitle C, with its comprehensive "cradle to grave" management requirement, is not well suited to this type of gap-filling regulation. EPA concluded that it would be more efficient and appropriate to fill the gaps by strengthening under the Clean Water Act and UIC programs and promulgating the remaining rules needed under RCRA under the less prescriptive statutory authorities set out in Subtitle D. This narrower approach would also reduce disruption of existing State and Federal control programs.

Thus, the Agency has decided not to promulgate regulations under Subtitle C for wastes generated by the exploration, development, and production of crude oil, natural gas, and geothermal energy for the following reasons:

(1) Subtitle C does not provide sufficient flexibility to consider costs and avoid the serious economic impacts that regulation would create for the
industry's exploration and production operations;

(2) Existing State and Federal regulatory programs are generally adequate for controlling oil, gas, and geothermal wastes. Regulatory gaps in the Clean Water Act and UIC program are already being addressed, and the remaining gaps in State and Federal regulatory programs can be effectively addressed by formulating requirements under Subtitle D of RCRA and by working with the States;

(3) Permitting delays would hinder new facilities, disrupting the search for new oil and gas deposits;

(4) Subtitle C regulation of these wastes could severely

strain existing Subtitle C facility capacity;

(5) It is impractical and inefficient to implement Subtitle C for all or some of these wastes because of the disruption and, in some cases, duplication of State authorities that administer programs through organizational structures tailored to the oil and gas industry; and

(6) It is impractical and inefficient to implement Subtitle C for all or some of these wastes because of the permitting burden that the regulatory agencies would incur if even a small percentage of these sites were considered Treatment, Storage and Disposal Facilities (TSDFs).

The Agency plans a three-pronged approach toward filling the gaps in existing State and Federal regulatory programs by:

(1) Improving Federal programs under existing authorities in Subtitle D of RCRA, the Clean Water Act, and Safe Drinking Water Act;

(2) Working with States to encourage changes in their regulations and enforcement to improve some programs; and

(3) Working with the Congress to develop any additional statutory authority that may be required.

EPA plans to revise its existing standards under Subtitle D of RCRA, tailoring these standards to address the special problems posed by oil, gas, and geothermal wastes and filling the regulatory gaps. Also, the Agency is moving ahead with improvements in its NPDES and UIC programs under the Clean Water Act and the Safe Drinking Water Act. EPA also plans to work with Congress to obtain any additional authorities that may be required. For example, Subtitle D of RCRA currently does not provide EPA with the authority to address treatment or transportation of wastes. Throughout the process of improving the Federal regulatory program, EPA will work closely with States to encourage improvements in their regulatory programs.

II. Background

Section 3001(b)(2)(A) of the Solid Waste Disposal Act of 1980 (Pub. L. 96-480), which amended the Resource Conservation and Recovery Act of 1976 (RCRA), prohibits EPA from regulating under RCRA Subtitle C "drilling fluids, produced waters, and other wastes associated with exploration, development, or production of crude oil or natural gas or geothermal energy" until at least 6 months after the Agency completes and submits to Congress a comprehensive study required by section 8002(m) (also added by the 1980 amendments). Section 8002(m) directs EPA to conduct

[A] detailed and comprehensive study and submit a report on the adverse effects, if any, of drilling fluids, produced waters, and other wastes associated with the exploration, development, or

production of crude oil or natural gas or geothermal energy on human health and the environment, including, but not limited to, the effects of such wastes on humans, water, air, health, welfare, and natural resources and on the adequacy of means and measures currently employed by the oil and gas and geothermal energy drilling and production industry, Government agencies, and others to dispose of and utilize such wastes to prevent or substantially mitigate such adverse effects.

The study way to include an analysis of:

1. The sources and volumes of discarded material generated per year from such wastes;

2. Present disposal practices;

3. Potential danger to human health and the environment from surface runoff or leachate;

4. Documented cases that prove or have caused danger to human health and the environment from surface runoff or leachate;

5. Alternatives to current disposal methods;

6. The cost of such alternatives; and

7. The impact of those alternatives on the exploration for, and development and production of, crude oil and natural gas or geothermal energy.

The 1980 amendments also added section 3001(b)(2)(B), which requires the Administrator to make a "regulatory determination" regarding the waste excluded from RCRA Subtitle C regulation. Specifically, within 6 months after submitting the Report to Congress, and after the opportunity for public hearings and public comment on the report, the Administrator must "determine to promulgate regulations" under RCRA Subtitle C for oil, gas, and geothermal energy waste, "or that such regulations are unwarranted." Section 3001(b)(2)(C) also specifies that any new regulations under RCRA Subtitle C for the crude oil, natural gas, or geothermal energy industry would not take effect until authorized by an Act of Congress

EPA was required to complete the study and submit it to Congress by October 1982. In August 1985, the Alaska Center for the Environment sued the Agency for its failure to complete the study by the statutory deadline. EPA entered into a consent order obligating it to submit the final Report to Congress on or before August 31, 1987, and to make its regulatory determination by

February 29, 1988. In April 1987, the court-ordered schedule was modified, extending the deadline or submittal of the final Report to Congress to December 31, 1987, and requiring the regulatory

determination to be made by June 30, 1988. In accordance with this schedule, EPA completed the technical report on methodology in October 1986, the technical report on the waste sampling and analysis in January 1987, the interim report in April 1987, the draft report in August 1987, and the final report in December 1987.

EPA's Report to Congress, "Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy," was **[Page 25448]** transmitted to Congress on December 28, 1987. A notice announcing the availability of the report, as well as the dates and locations of public hearings, was published on January 4, 1988 (53 FR 82). EPA held public hearings on the report in Washington, DC on February 23, 1988; Denver, Colorado, on February 25, 1988; San Francisco, California, on March 1, 1988; Anchorage, Alaska, on March 3, 1988; and Dallas, Texas, on March 8, 1988. The comment period on the report closed on March 15, 1988.

EPA's Report to Congress provides information on all of the study areas mandated by RCRA section 8002(m). The Agency received approximately 150 written comments on the report and heard testimony at the hearings from 105 individuals. All individual comments and transcripts from the public hearings are available for public inspection in the docket. The docket also contains a summary of all the comments presented at the hearings or submitted in writing, along with EPA's response to these comments.

A. Technical Summary of Report to Congress

1. Definition of Exempt Wastes

Section 3001(b)(2)(A) exempts produced water, drilling fluids, and "other wastes associated" with the exploration, development, and production activities. These are general terms that do not identify all of the specific waste streams to be exempted and studied. For study purposes, EPA broadly defined the scope of the exemption for oil, gas, and geothermal energy wastes to include not only produced waters and drilling fluids, but also related wastes (referred to herein as "associated wastes"), generated during the exploration, development, and production of crude oil, natural gas, and geothermal energy resources. The Agency excluded from its study those wastes not uniquely associated with exploration, development, and production of crude oil and natural gas which are not exempt from Subtitle C regulation (e.g., used batteries and waste solvents).

For geothermal energy, the definition of drilling-related wastes was identical to that of crude oil and natural gas wastes. Exempt wastes unique to geothermal energy production operations included: Waste streams produced from materials passing through the turbine in dry-steam power generation; waste streams resulting from a geothermal energy fluid or gas that passed through the turbine in flashed-stream

and binary power plants; waste streams resulting from the geothermal energy products passing through only the heat exchanger in binary operations or through the flash separator in the flash process; and most direct use waste streams. A more detailed description of the scope of the exemption and study appears in section IV.D. below.

2. Waste Quantities and Characterization

In the Report to Congress, EPA estimated that 361 million barrels of drilling waste were generated in 1985 from about 70,000 crude oil and natural gas wells, and that over 800,000 active production sites generated 20.9 billion barrels (including produced water injected for enhanced oil recovery (EOR)) of produced water during that year. Associated waste, such as workover fluids and tank bottoms, are produced at the rate of 11 million barrels per year. For geothermal energy wastes, EPA estimated that approximately 111,000 barrels of geothermal energy-related drilling wastes were generated in 1985, along with 56 billion gallons of liquid wastes (geothermal fluid and condensed steam) from both binary and flash process plants, and 8 billion gallons of liquid waste from direct use of geothermal energy.

For crude oil and natural gas wastes, EPA sampled liquids and sludges from several locations. Drilling fluids were sampled at drilling operations while produced water and tank bottoms were sampled at production operations. Samples from central treatment and disposal facilities and central pits contained mixtures of all wastes including associated wastes. The Agency found that organic pollutants at levels of potential concern (levels that exceed 100 times EPA's health-based standards) included the hydrocarbons benzene and phenanthrene. Inorganic constituents at levels of potential concern included lead, arsenic, barium, antimony, fluoride, and uranium.

Tank bottoms, an associated waste sampled and analyzed by the Agency, contained significant levels of contaminants of concern, with some levels exceeding the reference doses (RfDs) for noncarcinogens or the risk-specific doses (RSDs) for carcinogens (health-based standards) for these contaminants. n2

n2 It is the Agency's policy to consider Maximum Contaminant levels (MCLs) (established by the Office of Drinking Water) when available. Where an MCL has not been developed, RfDs for noncarcinogens and RSDs for carcinogens will be used to set

health-based limits. These terms are defined as follows:

-- Maximum Contaminant Level (MCL) is the enforceable drinking water standard, based on health and technical feasibility, attained at the tap. This measure is used when ground water is the main exposure pathway.

-- Reference Dose (RfD) is an estimate (with uncertainty spanning

perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime." [Integrated Risk Information System (IRIS) Vol. 1, Supplementary Documentation Appendix A, EPA/600/8-86/032A.]

-- Risk-Specific Dose (RSD) is the daily dose of a carcinogen received over a lifetime that will result in an incidence of cancer equal to the specific risk level. The risk level of A and B carcinogens is 10E -6 (1 in 1 million) and for C carcinogens it is 10E -5 (1 in 100,000). [51 FR 21667, June 13, 1986.] The classes of carcinogens are: Class A = human carcinogen, Class B = probable human carcinogen, Class C = possible human carcinogen. [Both RfDs and RSDs are converted into medium specific concentrations using intake assumptions for selected routes of exposure. They are expressed in mg/kg/day. Surface and ground water (ingestion): 2 liters/day for a 70-kg adult for a 70-year exposure. Air (inhalation): 20 cubic meters air/day for a 70-kg adult for a 70-year exposure.]

Analysis of the constituents of several geothermal energy waste streams indicated that some of the production wastes exhibited the corrosivity characteristic and extraction procedure (EP) toxicity for certain metals. Factors such as management practices, dilution and attenuation of the contaminant, and hydrogeological characteristics, affect the risk to human
health and the environment presented by these chemicals.

3. Current and Alternative Management Practices

A wide range of management practices are employed for crude oil and natural gas wastes. The technological diversity is the result of widely varying geological, climatological, ecological, topographic, economic, geographic, and age differences among drilling and production sites across the country and
partially account for varying State regulatory requirements. There are, however, variations from State to State in the stringency of management practices which are not wholly attributable to the varying physical settings of the operations.

Current practices include the use of reserve pits for drilling wastes; landspreading of reserve pit contents; disposal of produced waters through Class II underground injection wells;

disposal of produced water in unlined pits; discharge of produced water to surface waters; roadspreading; use of commercial facilities for treatment and disposal of drilling wastes and produced water; and some practices unique to the Alaska North Slope, such as the use of semipermanent production-related reserve pits, and discharges to the tundra. Less frequently used current **[Page 25449]** practices discussed in the report are closed-cycle drilling mud systems, annular disposal of produced water and drilling fluid, and trenching of reserve pits to dispose of reserve pit fluids.

These practices vary substantially in the protection they provide to the environment. While changes in State regulatory requirements over the years have led generally to the use of more environmentally protective technologies and management practices, there is a need for increased movement to more protective approaches for discharge to ephemeral streams, surface water discharges in estuaries in the Gulf Coast region, road applications of reserve pit contents and discharge to tundra in the Arctic, and annular disposal of produced waters.

For the major waste streams, EPA was unable to identify any new technologies in the research and development stage that offer promise for wide application in the near term. More widespread use of the best existing technologies, however, would provide substantial additional protection for the environment in many areas.

Waste management practices unique to geothermal power generation wastes include closed-cycle ponding, reinjection into the producing zone or a nonproducing zone, and consumptive secondary use. In California, production wastes are tested for hazardousness, using the California tests for hazardousness, before disposal to determine the appropriate disposal method.
After direct use of geothermal energy fluid for heating purposes, these fluids can be discharged to surface waters, injected into the producing zone or a nonproducing zone, and consumed by secondary uses.

4. Evidence of Damages

To determine the types and severity of damages caused by crude oil and natural gas wastes, EPA assembled information on a substantial number of damage cases, 62 of which were fully documented and passed EPA's "tests of proof." These cases were based on recent information gathered from the States of Alaska, Arkansas, California, Kansas, Kentucky, Louisiana, Michigan, New Mexico, Ohio, Oklahoma, Pennsylvania, Texas, West Virginia, and Wyoming. These damage cases were extensively reviewed by the States, industry, and third parties. On the basis of all available information, the study found that wastes from crude oil and natural gas operations have endangered human health and

caused environmental damage when managed in violation of State and Federal requirements. In some instances damage occurred where wastes are managed in accordance with currently applicable State and Federal requirements.

The major categories of wastes responsible for damages include reserve pit wastes, fracturing and acidizing fluids, stimulation chemicals, waste crude oil, produced water, and other miscellaneous wastes generated by the exploration, development, and production of crude oil and natural gas. The various categories of damages to, or endangerment of, human health and the environment contained in the

Report to Congress include:

-- Damage to agricultural land, crops, ephemeral streams, livestock, and threats to endangered species, fish, and other aquatic life in estuaries and bays from produced water and drilling fluids;

-- Degradation of soil and ground water from runoff and leachate from central treatment and disposal facilities, reserve pits, and unlined disposal pits;

-- Potential contamination of aquatic and bird life in estuaries and bays by metals and polycyclic aromatic hydrocarbons resulting from the discharge of drilling fluids and produced waters;

-- Potential for endangerment of human health from consumption of contaminated fish and shellfish and from ground water contaminated by seepage from storage and disposal pits;

-- Potential damage to tundra on the Alaska North Slope from roadspreading and seepage and discharges from reserve pits;

-- Damage to ground water, agricultural land, and domestic and irrigation water caused by seepage of native brines from improperly plugged and unplugged abandoned wells; and

-- Ground-water degradation from improper functioning of injection wells.

5. Risk Modeling

EPA used quantitative modeling and a review of the scientific literature to evaluate the health and environmental risks associated with management of oil, gas, and geothermal energy wastes in order to evaluate risks to human health and the environment under a variety of conditions. The Agency characterized selected major risk-influencing factors associated with current operations: Estimated the management of drilling waste in reserve pits, the underground injection of produced water, and the surface water discharge of produced water from

stripper wells. The risk analysis did not consider annular disposal, storage of produced water in surface impoundments, migration of produced water contaminants through fractures, unplugged or improperly plugged and abandoned wells, landspreading, roadspreading, or disposal of associated wastes.

For the selected practices, EPA estimated distributions of these risk-influencing factors across the population of crude oil and natural gas facilities; evaluated these factors in terms of their relative effect on risks; and developed initial quantitative estimates of the possible range of baseline health and environmental risks for the variety of conditions found. Risks were analyzed under

assumptions that were broadly consistent with baseline requirements of existing Federal and State programs.

For the specific subset of current practices, EPA modeled the potential effects of arsenic, benzene, boron, sodium, chloride, cadmium, chromium, and total mobile ions at concentrations observed in sampled produced water and drilling waste. The study focused heavily on ground water and indicated that, for the vast majority of the scenarios modeled, risks from the disposal of drilling waste in onsite reserve pits and the disposal of produced water by underground injection were small. Only a few chemicals from either source appear to be of major concern relative to health or environmental risk. The actual human health and environmental threats posed by any of these releases is largely dependent upon site-specific factors, including geophysical conditions and a site's proximity to human populations or sensitive ecosystems. Estimated impacts on human health varied widely, and there were typically a few combinations of environmental settings and high sample toxic constituent concentrations where moderate risks were projected. Quantitative risk modeling indicates the potential in some situations for carcinogenic risks in excess of 1 in 10,000 and sodium levels in drinking water in excess of recommended levels for public drinking water supplies. Modeling of resource damages to ground and surface water generally did not show significant risks at low release rates typical of individual stripper wells although multiple strippers discharging into common water courses were not modeled.

6. Costs and Economic Impacts

EPA developed three estimates of the compliance costs and economic impacts of implementing alternative waste management practices for the large-volume drilling wastes and produced waters in the crude oil and natural gas industries: (1) a "baseline" scenario reflecting current waste management practices; (2) an "intermediate" scenario, in which somewhat stricter **[Page 25450]** controls on waste disposal practices are assumed; and (3) a "Subtitle C" scenario, in which virtually full 53 FR 25450

RCRA hazardous waste requirements would be met. EPA estimated total annual costs for each scenario and then evaluated the projected economic impacts of these costs on the oil industry as a whole.

Assuming produced waters reinjected for enhanced production would not be regulated, total annual costs for additional management requirements ranged from approximately $50 million to over $6.7 billion, depending on the scenario and on assumptions regarding the fraction of wastes (10 to 70 percent) that would be handled as RCRA-hazardous under each scenario. Estimated costs for the Subtitle C scenario ranged between $1 billion and $6.5 billion without including land-ban and corrective action costs.

Production declines related to these increased waste management

costs could range up to 12 percent in the year 2000. Other impacts also varied greatly under different scenario assumptions. Net impacts on oil prices per barrel could range up to $0.76 per barrel, with projected maximum costs to consumers of $4.5 billion per year, and increases in the U.S. balance of payments deficit of up to $11 billion.

A significant part of any overall economic impact of new requirements would be their effects on stripper wells. Stripper operations (generally, wells producing 10 or fewer barrels of oil per day during the declining phase of their production cycle) cumulatively contribute about 14 percent of total domestic oil production. Generation of production wastes by strippers is more significant than would be expected, however, because many strippers produce very high ratios of water to oil. Many stripper operations are economically marginal and are thus highly sensitive to small fluctuations in market prices and cannot easily absorb additional costs for waste management. Stripper operations, therefore, constitute a special subcategory of the crude oil and natural gas industry and should be given special consideration when developing recommendations for improvements in the management of crude oil and natural gas wastes. At the same time, any additional regulations must recognize the great diversity that exists within the stripper industry. The nature of stripper operations is dependent on the volume of crude oil, natural gas and wastes generated, the age of the well, the technology in use, geological, environmental, and economic considerations, and types of ownership. For example, a family-owned stripper well in a century-old field in Appalachia bears little resemblance to a field of stripper wells owned by a single large petrochemical company in California. Regulations governing wastes generated by stripper wells must be tailored to meet this great diversity.

B. Legal Authority

Section 3001(b)(2)(B) of RCRA requires EPA to determine either to promulgate regulations under Subtitle C for oil, gas, and geothermal energy wastes, or that such regulations are "unwarranted." This section thus gives EPA broad discretion both to identify what factors to consider and to determine what balance of factors permit the conclusion that Subtitle C regulations are unwarranted.

EPA has concluded that its decision whether to regulate oil, gas and geothermal energy waste under Subtitle C should be based not just on whether that waste is hazardous (as currently defined by EPA regulations) but also on a consideration of the other factors section 8002(m) required EPA to study. The basis of this conclusion is the language of section 3001(b)(2)(B), which states that in making the regulatory determination " the Administrator shall utilize the information developed or accumulated pursuant to the study required

under section 8002(m)." Clearly, Congress envisioned that the determination would be based on all the considerations stated in section 8002(m).

In reviewing sections 3001(b) and 8002(m), together with the legislative history of these provisions, EPA has concluded that Congress believed certain considerations to be particularly important to the regulatory determination. First, Congress instructed EPA to study the potential dangers to human health and the environment from oil, gas and geothermal energy waste, indicating that any decision to regulate under Subtitle C must be based on a finding of such danger. Second, section 8002(m) required EPA to study "the adequacy of means and measures currently employed by * * * Government agencies * * * to dispose of and utilize such wastes and to prevent or substantially mitigate such adverse effects." The section also permits EPA to review the actions of other Federal agencies, "with a view toward avoiding duplication of effort," and requires the Agency to include in its report of the study "recommendations for Federal and non-Federal actions concerning" the effects of oil, gas and geothermal energy wastes on health and environment. Thus, Congress was concerned that regulations under Subtitle C should not be promulgated "until further information is developed to determine whether a sufficient degree of hazard exists to warrant additional regulations and whether existing State or Federal programs adequately control such hazards." S. Rep. No. 172, 96th Cong., 1st Sess. (1979), at 6. Congress apparently believed that EPA should not impose Subtitle C regulation unless other programs could not adequately control any hazards identified.

In addition, Congress instructed EPA to analyze fully the disposal practices of the industry, including present practices, alternatives, the cost of alternatives, and the impact of alternatives on the exploration for, and development and production of, crude oil and natural gas and geothermal energy. Thus, EPA was required to consider the impact of Subtitle C regulations on existing hazardous waste facilities, and both the cost and impact of such regulations on the oil, gas and geothermal industries. Clearly, Congress believed that Subtitle C regulation would be unwarranted if it had severe impacts on the nation's future energy production capabilities.

C. Conclusions of the Report to Congress and Response to Comments

Based on the study done by EPA, the Report to Congress developed a number of initial general conclusions. Extensive comments were received on these conclusions. A summary of the comments and EPA's response follows each conclusion (underlined statements) below.

1. Available waste management practices vary in their environmental performance. Some individuals argued that since crude oil and natural gas operations very significantly across the country, Federal regulations could not be effectively enforced or applied, and would therefore not be beneficial. Other commenters focused on local issues and regional environmental problems, calling for increased

Federal regulations to solve them. Still others observed that the crude oil and natural gas industry does not manage its "hazardous" wastes in the same manner as other industries manage similar hazardous wastes.

The Agency acknowledges that there are valid reasons for differences in practices among areas. This points to a need for individual, tailored regulations at the State and local level for the management of these wastes, rather than a RCRA Subtitle C program. The Agency also agrees, however, that there may be a need for minimum Federal standards covering basic waste management practices. The Agency agrees that because of the large volumes of these wastes, along with the other **[Page 25451]** factors discussed in the report, some crude oil and natural gas wastes require different disposal methods than may be used for management of wastes generated by other industries.

2. Any program to improve management of oil and gas wastes in the near term will be based largely on technologies and practices in current use. Commenters agreeing with this conclusion asserted that existing technologies are adequate and that new technologies would be economically infeasible and would serve no valid purpose. Others, especially those concerned with issues in Alaska, believe that many new technologies are available but seldom used and called for their increased use. A few State regulatory agencies called for increased technical assistance and guidance from EPA.

The Agency continues to believe that there are very few techniques that are not in use under some conditions. There is, however, a need to disseminate knowledge and encourage or perhaps require adoption of improved methods nationwide. States and the

industry should continue to develop, refine, and encourage the implementation of new and improved waste management techniques.

3. Increased segregation of waste may help improve management of oil and gas wastes. Many commenters strongly opposed the proposal for segregation of wastes and believed that the scope of the exemption in RCRA section 3001 should be construed to include, and should be maintained for, all associated wastes in addition to the currently exempt large-volume wastes. Many commenters asserted that mixing various wastes with produced water prior to injection is environmentally safe and economically beneficial. Other commenters argued that each waste stream generated by the crude oil and natural gas industry should be tested separately to determine its RCRA characteristics and that wastes determined to be hazardous according to RCRA definitions should remain segregated and be disposed of according to RCRA regulations. Some individuals claimed that many hazardous wastes generated by the crude oil and natural gas industry are commingled with nonhazardous wastes prior to landspreading or injection, causing significant environmental damage.

The Agency believes that under certain circumstances waste segregation is technically and economically feasible and environmentally desirable.

4. Stripper operations constitute a special subcategory of the oil and gas industry. Many commenters strongly agreed with this conclusion, stating that new or additional Federal regulations would be financially harmful to already economically ailing stripper well operators. Other commenters were of the opinion that some stripper wells can cause significant environmental damage, which must ultimately be paid for through general taxes. Some commenters urged that stripper operations should be treated in the same manner as the rest of the crude oil and natural gas industry.

As previously described, the agency recognizes that many, though not all, stripper operations are economically vulnerable to any new regulatory burdens. Stripper wells in many parts of the country are also associated with smaller, independent oil and gas companies that do not have flexibility in pricing and may suffer disproportionate economic impacts from any additional regulation. The Agency is required under the Regulatory Flexibility Act to evaluate impacts of any new regulations on small business enterprises.

5. Documented damage cases and quantitative modeling results indicate that, when managed in accordance with State and Federal requirements, exempt oil and gas wastes rarely pose significant threats to human health and the environment. Opinion on this conclusion was sharply divided. Some commenters strongly agreed, saying that State regulations are fully adequate to control crude

oil and natural gas operations and challenged the validity of a few selected damage cases. Others strongly opposed this conclusion, saying that State and Federal regulations are inadequate and seldom enforced. A number of commenters stated that many documented damage cases were omitted from the final Report to Congress. Some commenters provided studies and analytical data alleging environmental damage from crude oil and natural gas wastes; others claimed that the risk modeling conducted for the Report underestimated damage to the environment and did not adequately characterize the significance of human health risks from crude oil and natural gas wastes.

A number of comments were received on the quantitative risk modeling on which this conclusion is partly based. Criticisms included:

-- The quantitative risk modeling should not have been performed at all because of the severe lack of suitable data.

-- The risk analysis is fatally flawed because it used nonconservative assumptions.

-- Values for input parameters used in the liner location model (LLM) have been developed on the basis of limited data, worst-case assumptions, or modeling limitations.

-- The study underestimates toxicity because too much of the sampling was performed on diluted and weathered crude oil and natural gas wastes.

-- Very few of the contaminants at the waste sites were analyzed.

-- EPA made no effort to correlate its quantitative risk model with the actual damage cases.

-- The health-based standards incorporated in the model are insufficiently documented.

-- TCLP extractions used in risk modeling for reserve pits misrepresent conditions at pits.

-- Risk is overestimated in the risk analysis.

The Agency believes the damage cases in the Report to Congress demonstrate that violations of existing State and Federal requirements lead to most observed damages, although some damages have been shown to result from practices currently allowable in some States. The risk assessment also showed little risk at most locations from the management practices that were analyzed. The Agency believes from the available evidence that State regulations are generally but not entirely adequate for

management of crude oil and natural gas wastes. Additionally, enforcement of and compliance with State regulations vary widely from State to State.

With respect to the specific criticisms of the risk modeling, the Agency disagrees that the modeling should not have been performed because of a severe lack of suitable data. Extensive data were gathered from a variety of sources, including EPA field investigation and waste sampling study, numerous Federal and State agencies, an industry survey conducted by API, comments submitted on interim reports and given during peer review meetings, over 300 topographic maps, automated data bases, and a general literature review. The Agency believes these data are the best available and that they adequately support a risk assessment.

As with any detailed modeling study, a number of assumptions in the risk assessment had to be made, sometimes with respect to values used for model inputs. The Agency rejects the notion, however, that the assumptions made were generally worst-case, significantly nonconservative, or driven only by modeling limitations. For most variables, several realistic representative values were selected to evaluate a variety of circumstances. Whenever assumptions were made,

best available data and **[Page 25452]** professional judgment were used and proposed approaches were subjected to peer review, and often outside public review. As noted in the above comments, some of the assumptions tended to result in either overestimates or underestimates of risk. While over- and underestimates are inevitable in any predictive modeling, the Agency believes their impacts on this study have been minimized by (1) analyzing risks under a wide range of conditions across the industry as a whole, in an attempt to even out over- and underestimates of risk for any single scenario; and (2) fully documenting each assumption and its likely effect on risk estimates.

The Agency disagrees that the waste characterization used in the risk assessment was inappropriate. Many of EPA's samples of drilling waste were taken from open reserve pits where the waste could have been "weathered", but these samples were not purposefully diluted and are believed to be representative of drilling waste as it exists in a reserve pit. Contrary to the above comment, all of the contaminants detected in drilling pit waste and produced water were reviewed and considered as candidates for the risk assessment. The eight constituents selected for quantitative modeling were the constituents judged most likely to contribute most significantly to risk to health or the environment. The selection of contaminants for quantitative modeling was based on their frequency of detection, concentration, inherent toxicity, and mobility and persistence in the environment. Finally, the Agency used TCLP extraction results only to model leachate from closed reserve pits (not from

operating pits). While uncertainties concerning the applicability of TCLP tests to leachability of reserve pit wastes are acknowledged, the Agency believes the TCLP results were the best data available for modeling this leachate.

The Agency did not attempt to correlate the risk modeling with the damage cases because the risk assessment was intended to complement the damage cases by focusing on different issues. Specifically, the risk assessment analyzed potential current and future effects assuming compliance with a limited subset of typical existing regulations, whereas the damage cases covered past and current effects, many of which were for incidents involving regulatory violations. The risk assessment also focused on more subtle or very long-term impacts, some of which possibly would not be evidenced in the contemporary damage case file. In addition, several of the damage cases represented situations (e.g., releases through abandoned boreholes) that could not be
modeled adequately given existing data and modeling techniques. Other scenarios not modeled include annular deposits, storage of produced water in surface impoundments, migration of produced water contaminants through fractures, and landspreading. (Use of impoundments for produced waters and landspreading are both still frequently practiced.)

The Agency believes that the health-based standards incorporated in the risk model incorporated the best available scientific knowledge at the time of the study. These standards and the studies that support them were summarized only briefly in the Report to Congress; readers are referred to the two-volume technical background report on risk assessment for more detail. n3

n 3 U.S. EPA, December 1987. Office of Solid Waste. Onshore Oil and Gas Exploration, Development and Production: Human Health and Environmental Risk Assessment.

6. Damages may occur in some instances even where wastes are managed in accordance with currently applicable State and Federal requirements. No comments specifically addressed this conclusion, but comments on the previous conclusion relate in part to the substance of this one.

The quantitative risk modeling showed that for the specific management practices and scenarios modeled, a few crude oil and natural gas sites (less than five percent) could pose significant risks even if drilling waste and produced water were managed in accordance with existing regulations. In addition, the damage case results indicate that some waste management practices permitted in some States can have undesirable environmental impacts. These practices include landspreading of high chloride drilling mud, annular disposal of produced water, discharge of produced water and drilling fluids to tidally affected wetlands,

discharge of produced water to live streams, and discharge of reserve pit contents to tundra.

7. Unplugged and improperly plugged abandoned wells can pose significant environmental problems. Opinion on this conclusion was divided. Many of the commenters asserted that there is no evidence to support this conclusion, and that State regulations adequately address the potential problems associated with unplugged and improperly plugged and abandoned wells. Others felt that it is economically infeasible to plug or re-plug abandoned wells properly. Conversely, commenters agreeing with this conclusion mentioned specific instances in which unplugged wells have caused significant contamination of ground-water supplies. Some State regulatory agencies commented that inadequate funds are available to properly plug all abandoned wells.

The Agency believes there is adequate evidence to indicate a potential threat to ground water from unplugged and improperly plugged abandoned wells based on the large number of unplugged or improperly plugged abandoned wells, the difficulty in observing plugging of abandoned wells, and the difficulty in enforcing State regulations on plugging of abandoned wells. The damage cases collected and the information presented to the Agency support this conclusion. The Agency recognizes that the full extent of the problem is not well defined. The Agency also recognizes that high costs could

be incurred if all unplugged or improperly plugged abandoned wells were required to be plugged, and that such a requirement may not be necessary, as not all unplugged or improperly plugged abandoned wells pose a problem.

8. Discharges of drilling muds and produced waters to surface waters have caused locally significant environmental damage where discharges are not in compliance with State and Federal statutes and regulations or where NPDES permits have not been issued. Comments were divided on this issue even among those who were critical of similar conclusions; some agreed, while others stated that there is no evidence that drilling muds or produced water cause environmental damage. Some stated that both drilling muds and produced water are relatively nonhazardous and nontoxic. Several comments specific to Alaska stated that the Clean Water Act adequately regulates the management of large-volume wastes in Alaska.

Those agreeing with this conclusion often argued that current State and Federal regulations are not adequate or are not enforced properly. They also asserted that drilling muds and produced waters contain RCRA hazardous constituents and have caused significant environmental damage.

Documented damage cases indicate that disposal of drilling muds and produced waters in violation of State regulations and where NPDES permits have not been issued, has clearly caused

damages to the environment and endangered human health, particularly **[Page 25453]** in Alaska, the Gulf Coast and the Appalachian States. Also, discharges of produced water from stripper well to surface waters were estimated to cause cancer risks greater than one in one hundred thousand in roughly 17 percent of the conservative cases studied in the quantitative risk modeling for 90th percentile produced water constituent concentrations.

9. For the nation as a whole, regulation of all oil and gas field wastes under unmodified Subtitle C of RCRA would have a substantial impact on the U.S. economy. Those agreeing with this conclusion did so strongly, stating that RCRA regulations applied to the crude oil and natural gas industry would cause the loss of a significant number of jobs. Some said that RCRA regulation would increase oil imports and pose a threat to national security. Others claimed that the potential costs to industry have been underestimated.

Those in favor of regulating wastes determined to be RCRA-hazardous generally recognized the potential economic impacts of regulation, but nevertheless believed that such wastes should be disposed of consistent with RCRA Subtitle C requirements.

In specific comments on the methodologies used to analyze these issues, some commenters believed that the lower 48 State model masks or understates costs and impacts in some regions, and that data

limitations and exclusions of some costs lead to understated economic impacts in all scenarios. Some commenters stated that the number of economically marginal wells that would be forced to shut down if RCRA Subtitle C regulations were imposed has been underestimated, and that certain assumptions in the model are unrealistic. Some commented that the analysis ignores impacts on undiscovered energy reserves and gas production.

Taking the opposite point of view, other commenters argued that the cost analysis ignores public health costs associated with continued improper disposal of crude oil and natural gas wastes, and that the report does not take into account the financial consequences of contamination of ground water and other natural resources. Some claimed that long-term financial burdens to taxpayers to mitigate environmental damage, to provide health care, and to sustain financial burden from lost productivity, will be greater than the cost to the crude oil and natural gas industry to prevent that damage.

The Agency believes that its estimates of impacts to the industry of full regulation under RCRA Subtitle C are reasonable and that such impacts would be substantial. The Agency acknowledges that costs related to public health effects and

contamination of ground water and other natural resources because of improper disposal of crude oil and natural gas wastes have not been determined.

10. Regulation of all exempt wastes under full, unmodified RCRA Subtitle C appears unnecessary and impractical at this time. Opinion was divided on this conclusion. Those agreeing did so strongly, while those opposed generally stated that if a waste is RCRA hazardous, it should be treated under RCRA regulations regardless of its origin. Many of those in disagreement with this conclusion argued that the crude oil and natural gas industry can afford the financial burden of RCRA regulation.

For reasons described in Section IV of this regulatory determination, the Agency continues to believe that regulation of all crude oil and natural gas wastes under RCRA Subtitle C is unnecessary and impractical. The Agency believes that these wastes can be managed in a manner so as to protect human health and the environment without regulating them under RCRA Subtitle C.

11. States have adopted variable approaches to waste management. Most commenters agreed with this conclusion, but there was considerable disagreement over whether current State regulations are adequately designed and enforced.

Variable approaches to waste management are partly the result of varying environmental conditions, geology, and economics among the producing States. EPA believes, however, that there are many cases

where more stringent requirements are both feasible and desirable, and that many States have recognized this in changes made to their regulations in the last few years. Some States have taken significant leadership roles in the development of more environmentally protective requirements.

12. Implementation of existing State and Federal requirements is a central issue in formulating recommendations in response to section 8002(m). Opinion was divided on this conclusion. Some commenters urged that existing State and Federal regulations are adequate and that additional State or Federal regulations are unnecessary and impractical. Others argued that existing State and Federal regulations have not been adequately enforced and that additional Federal regulations are necessary.

The Agency believes that the design, enforcement, and implementation of existing State and Federal regulations can clearly be improved.

Public comments on the Geothermal Energy Portion of Report to Congress: Only two comments specifically addressed geothermal energy wastes.

One commenter presented additional information relating to damages resulting from the offsite disposal of geothermal energy production wastes (such as hydrogen sulfide abatement wastes which test nonhazardous by California standards) in commercial facilities. The information alleged potential damages and/or risk by contamination of surface and ground water from the disposal of hydrogen sulfide abatement wastes in centralized or commercial disposal facilities in California. These facilities are designated strictly for the disposal of geothermal energy production wastes determined to be nonhazardous by California standards.

The other commenter specifically addressing geothermal energy, fully supported the conclusions of the report and stated that the California statutes regarding the management of geothermal energy wastes are comprehensive and effective.

The Agency continues to believe that geothermal energy wastes are generally well regulated under existing State and Federal programs. However, the Agency acknowledges that at least one significant undesirable disposal practice is occurring and has taken this into consideration in making this final regulatory determination.

D. Determination of the Scope of the Temporary RCRA Exemption

Based on the language of RCRA section 3001(b)(2)(A) of the 1980 amendments to RCRA, review of the statute, and supporting legislative history, the Agency believes that the following wastes were included

in the temporary exemption set forth in the statute.

-- Produced water;

-- Drilling fluids;

-- Drill cuttings;

-- Rigwash;

-- Drilling fluids and cuttings from offshore operations disposed of onshore;

-- Geothermal production fluids; and

-- Hydrogen sulfide abatement wastes from geothermal energy production.

-- Well completion, treatment, and stimulation fluids;

-- Basic sediment and water and other tank bottoms from

storage facilities that hold product and exempt waste; **[Page 25454]**

-- Accumulated materials such as hydrocarbons, solids, sand, and emulsion from production separators, fluid treating vessels, and production impoundments;

-- Pit sludges and contaminated bottoms from storage or disposal of exempt wastes;

-- Workover wastes;

-- Gas plant dehydration wastes, including glycol-based compounds, glycol filters, filter media, backwash, and molecular sieves;

-- Gas plant sweetening wastes for sulfur removal, including amines, amine filters, amine filter media, backwash, precipitated amine sludge, iron sponge, and hydrogen sulfide scrubber liquid and sludge;

-- Cooling tower blowdown;

-- Spent filters, filter media, and backwash (assuming the filter itself is not hazardous and the residue in it is from an exempt waste stream);

-- Packing fluids;

-- Produced sand;

-- Pipe scale, hydrocarbon solids, hydrates, and other deposits removed from piping and equipment prior to transportation;

-- Hydrocarbon-bearing soil;

-- Pigging wastes from gathering lines;

-- Wastes from subsurface gas storage and retrieval, except for the nonexempt wastes listed below;

-- Constituents removed from produced water before it is injected or otherwise disposed of;

-- Liquid hydrocarbons removed from the production stream but not from oil refining;

-- Gases from the production stream, such as hydrogen sulfide and carbon dioxide, and volatilized hydrocarbons;

-- Materials ejected from a producing well during the process

known as blowdown;

-- Waste crude oil from primary field operations and production; and

-- Light organics volatilized from exempt wastes in reserve pits or impoundments or production equipment.

The Agency believes that the following wastes were not included in the original exemption:

-- Unused fracturing fluids or acids;

-- Gas plant cooling tower cleaning wastes;

-- Painting wastes;

-- Oil and gas service company wastes, such as empty drums, drum rinsate, vacuum truck rinsate, sandblast media, painting wastes, spent solvents, spilled chemicals, and waste acids;

-- Vacuum truck and drum rinsate from trucks and drums transporting or containing non-exempt waste;

-- Refinery wastes;

-- Liquid and solid wastes generated by crude oil and tank bottom reclaimers;

-- Used equipment lubrication oils;

-- Waste compressor oil, filters, and blowdown;

-- Used hydraulic fluids;

-- Waste solvents;

-- Waste in transportation pipeline-related pits;

-- Caustic or acid cleaners;

-- Boiler cleaning wastes;

-- Boiler refractory bricks;

-- Boiler scrubber fluids, sludges, and ash;

-- Incinerator ash;

-- Laboratory wastes;

-- Sanitary wastes;

-- Pesticide wastes;

-- Radioactive tracer wastes;

-- Drums, insulation, and miscellaneous solids.

In order to determine the scope of the exemption, the Agency reviewed the statute and legislative history. The Agency interprets the term "other wastes associated" to include rigwash, drill cuttings, and wastes created by agents used in facilitating the extraction, development and production of the resource, and wastes produced by removing contaminants prior to the transportation or refining of the resource. Drill cuttings and rigwash are generally co-mingled with drilling muds, and the Agency therefore has grouped them with large-volume wastes for purposes of discussion in this determination. The remaining wastes on the above list of exempt wastes are considered "associated wastes" for purposes of this determination.

The Agency has determined that produced water injected for enhanced recovery is not a waste for purposes of RCRA regulation and therefore is not subject to control under RCRA Subtitle C or RCRA Subtitle D. Produced water used in enhanced recovery is beneficially recycled and is an integral part of some crude oil and natural gas production processes. Produced water injected in this manner is already regulated by the Underground Injection Control program under the Safe Drinking Water Act. The Agency notes, however, that if the produced water is stored in surface impoundments prior to injection, it may be subject to RCRA Subtitle D regulations.

III. Factors Considered in Regulatory Determination

Section 3001(b)(2)(B) of RCRA states that in making the regulatory determination, the Agency must "utilize the information developed or accumulated pursuant to the study required under section 8002(m)." Clearly, Congress envisioned that the determination would be based on all factors specifically enumerated in section 8002(m), as well as general issues raised by the text of section 8002(m) as a whole. Therefore, in making today's determination, EPA considered not just the impact of these wastes on human health and the environment, but also the other factors that RCRA section 8002(m) required EPA to study.

Specifically, EPA considered three major factors in developing this determination: (1) The characteristics, management practices, and impacts of oil, gas, and geothermal wastes on human health and the environment; (2) the adequacy of existing State and Federal regulatory programs for controlling these wastes; and (3) the economic impacts of any additional regulations on the exploration for, and development and

production of, crude oil, natural gas, and geothermal energy. Section 8002(m) required EPA to study each of these factors.

IV. Regulatory Determination for Crude Oil and Natural Gas Wastes

The following discussion summarizes information on the three major factors (discussed above) used in making this regulatory determination and then presents EPA's conclusions and rationale for the regulatory determination for crude oil and national gas wastes. The information summarized here incorporates information received during the public comment period and additional refinement of the data presented in EPA's December 1987 Report to Congress.

A. Hazard Assessment

For the Report to Congress, EPA conducted a limited analysis which modeled the potential effects of disposal of drilling waste in reserve pits and the disposal of produced water by underground injection and found that the potential risks to human health and the environment were small. Only a few constituents appeared to be of major concern when these wastes are managed in accordance with existing State and Federal regulations. The actual threats posed were largely dependent upon site-specific factors such as populations or sensitive ecosystems. Other management practices such as storage of produced water in unlined pits were not modeled and may pose higher risks.

Analysis of field data collected by EPA and presented in the January 1987 technical report shows that a portion of oil and gas

wastes contain constituents **[Page 25455]** of concern above EPA health- or environmental-based standards. For example, wastes at 7 percent of the sites generating drilling fluids and 23 percent of the statistically weighted sample sites generating produced water contain one or more of the toxic constituents of concern at levels greater than 100 times the health-based standards. The constituents typically exceeding the standards in drilling fluids are fluoride, lead, cadmium, and chromium. The constituents exceeding the standards in produced water are benzene, arsenic, barium, and boron. In addition, wastes at 78 percent of the sample sites generating drilling fluids, and 75 percent of the sample sites generating produced water, contain chlorides at levels greater than 1,000 times the EPA secondary maximum contaminant level for chloride. Like large-volume wastes, associated wastes contain a wide variety of hazardous constituents. Many associated wastes contain constituents that are similar in chemical composition and/or toxicity to other wastes currently regulated under RCRA Subtitle C.

The presence of constituents in concentrations exceeding health- or environmental-based standards does not necessarily mean that these wastes pose significant risks to human health and the environment. In evaluating the risks to human health and the environment, several factors beyond the toxicity of the waste should be considered. These factors include the rate of release of contaminants from different management practices, the fate and transport of these contaminants in the environment, and the potential for human health or ecological exposure to the contaminants.

On the basis of available data, EPA can only roughly estimate how much currently exempt oil and gas waste would be considered hazardous under current or proposed RCRA Subtitle C standards. It is clear that some portions of both the large-volume and associated waste would have to be treated as hazardous if the Subtitle C exemption were lifted. EPA estimates that approximately 10 to 70 percent of large-volume wastes and 40 to 60 percent of associated wastes could potentially exhibit RCRA hazardous waste characteristics under EPA's regulatory tests.

EPA has documented 62 damage cases caused by crude oil and natural gas wastes. Because large-volume wastes and associated wastes are often managed and disposed of together, it is often difficult to isolate the specific waste stream that contributed greatest to the damage. However, available data does not indicate that significant damage can occur from mismanagement of both large-volume wastes and associated wastes. EPA believes that most of these damages could have been prevented if the wastes had been managed in accordance with existing State and Federal requirements. However, because of certain regulatory gaps, damages have occurred even where wastes are managed in compliance with existing requirements.

B. Economic Impact Analysis

Application of RCRA Subtitle C to exploration, development, and production wastes could be extremely costly if large portions of these wastes were hazardous. The Agency estimates that implementation of RCRA Subtitle C on 10 to 70 percent of the large-volume drilling waste and non-EOR produced water would cost the industry and consumers $1 billion to $6.7 billion per year in compliance costs (not including costs for land ban or corrective action regulations mandated by Congress). This would reduce domestic production by as much as 12 percent.

In response to questions raised subsequent to the Report of Congress, the Agency also conducted a preliminary evaluation of the likely range of potential compliance costs and industry impacts that could result from removal of the RCRA Subtitle C exemption for associated wastes. The Agency's preliminary estimate is that the cost to the crude oil and natural gas industry of RCRA Subtitle C management for associated wastes

would range between $200 million and $550 million per year. These cost estimates are based on American Petroleum Institute survey estimates on the quantities of associated wastes produced and their current management practices, together with the Agency assumption that 40 to 60 percent of these wastes might require management under RCRA Subtitle C, and Agency estimates of the probable range of unit costs for managing these various waste types.

However, it is important to note that these estimates do not include the cost of corrective action. The application of corrective action requirements to facilities that manage associated wastes on-site would impose substantial costs on the units managing the associated wastes as well as any other solid waste management units that exist within the facility boundaries to the extent that the wastes continue to be managed on-site. Since nearly half of the associated wastes are currently managed on-site, this could result in significant costs to the industry. The cost estimates also assume that "land-ban" treatment of hazardous solids and sludges consists of recycling and resource recovery. It is likely that some fraction of these wastes would need to be incinerated in compliance with the treatment standards established by the "land-ban," implying higher costs of regulating the associated wastes under Subtitle C.

C. Adequacy of State and Federal Regulatory Programs

EPA evaluated State regulations pertaining to large-volume wastes and associated wastes. Often, some of these wastes are co-mingled and disposed of together. Consequently, they are usually managed together under one regulatory program at the State level.

With regard to large-volume wastes, EPA found most existing State regulations are generally adequate for protecting human health and the environment. Most States have requirements specifically

controlling the management of drilling muds and produced waters. However, certain gaps do exist in State regulations for large-volume wastes. For example, some States do not have adequate requirements controlling roadspreading or landspreading of large-volume wastes, design or maintenance rules for reserve pits, or have insufficient management specifications for centralized and commercial disposal facilities. As noted previously, EPA also found damages which occurred due to surface discharges not prohibited by State regulation.

Another regulatory gap for some States are controls for associated wastes. Most State regulations do not include specific controls for the management of these wastes. General standards are often difficult to enforce unless a specific pollution incident is discovered and can be attributed to a particular

waste disposal event. However, a few States such as Texas do specifically address associated wastes and other States have general standards that provide partial control of these wastes.

The Agency has examined changes in State regulatory programs over the past two years. Some States have improved their regulatioins, while other States have relaxed specific waste management requirements. For example, while reserve pit management has been strengthened in some States, other States have relaxed controls pertaining to land application of large-volume wastes. Problems also remain regarding adequate State implementation and enforcement of existing regulations.

The Agency also evaluated the Federal Underground Injection Control **[Page 25456]** (UIC) program under the Safe Drinking Water Act and regulatory programs under the Clean Water Act. The UIC program effectively controls underground injection from the point of the wellhead, while the NPDES program addresses point source discharges to surface water bodies. These programs are particularly important in controlling management of large-volume wastes. However, EPA has identified certain gaps in these programs. For example, UIC regulations currently allow the practice of annular disposal and lack uniform mechanical integrity testing standards. The Clean Water Act regulatory program gaps include the lack of national effluent limitations at the Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) levels. These national limitations are needed to more effectively deal with discharges from facilities in the onshore and coastal subcategories of the industry. EPA also found that improvements are needed regarding implementation and enforcement of existing regulations. The Agency has already undertaken steps to address these deficiencies; these are discussed in Section V of today's notice.

Finally, EPA evaluated the existing Federal criteria under Subtitle D of RCRA. These criteria (40 CFR Part 257) include general environmental performance standards applicable to the disposal of any

solid waste, including oil, gas, and geothermal wastes. These criteria include among other things, standards related to surface water discharges, ground-water contamination, and endangered species. Because the programs' criteria are aimed principally at municipal solid waste, EPA believes they do not now fully address oil and gas waste concerns. In addition, many of these criteria, such as control of disease vectors and aviation hazards, are not appropriate for oil and gas waste. Nevertheless, EPA has authority under Subtitle D to tailor requirements appropriate for the disposal of oil and gas wastes.

D. Conclusions

The Agency has decided not to promulgate regulations under Subtitle C for large-volume and associated wastes generated by the exploration, development and production of crude oil and natural gas. The Agency decision is based on the following reasons:

(1) Subtitle C contains an unusually large number of highly detailed statutory requirements, some of which are not only extremely costly, but also are unnecessary for the safe management of oil and gas wastes. Subtitle C does not, however, allow the Agency to consider costs where applying these requirements to oil and gas wastes. Consequently, EPA would not be able to craft a regulatory program to reduce or eliminate the serious economic impacts that it has predicted. Thus, in light of Congress' concern for the protection of the nation's future energy supply, Subtitle C regulations must be considered unwarranted. A tailored Subtitle D program, by contrast, will enable the Agency to apply all necessary requirements to the management of these wastes, while ensuring that economic impacts are minimized.

(2) As discussed in Section II. B., Congress has indicated that Subtitle C regulations are unwarranted where existing programs can be employed to protect human health and the environment from the problems created by oil and gas wastes. EPA has concluded that, in fact, existing State and Federal programs are generally adequate, and that remaining gaps can be filled by modifying these programs. Subtitle C regulation is, therefore, unwarranted. Moreover, Subtitle C, with its comprehensive "cradle to grave" management requirement, simply is not well suited to this type of gap-filling regulation. It is thus both more efficient and appropriate to fill the gaps by strengthening regulations under the Clean Water Act and UIC program and promulgating the remaining rules needed under RCRA under the less prescriptive statutory authorities set out in Subtitle D.

(3) Since the States and EPA have consistently required long periods of time to process Subtitle C permits, regulation under Subtitle C could delay the start of operations at new facilities.

These delays would be particularly disruptive to the exploration phase of oil and gas development.

(4) Subtitle C regulation of these wastes would subject them to all of the land disposal restriction requirements, including BDAT, and thus could severely strain existing Subtitle C facility capacity.

(5) The Agency believes that it is impractical and inefficient to implement Subtitle C for all or some of these wastes because of the disruption and, in some cases, duplication of State authorities that administer programs through organizational

structures tailored to the oil and gas industry.

(6) It is impractical and inefficient to implement Subtitle C for all or some of these wastes because of the permitting burden that the regulatory agencies would incur if even a small percentage of these sites were considered Treatment, Storage and Disposal Facilities (TSDFs).

V. Efforts to Improve State and Federal Programs

The Agency plans a three-pronged approach toward filling the gaps in existing State and Federal programs that regulate the management of wastes from the crude oil, and natural gas, industries. This effort will include:

1. Improving Federal programs using existing authorities under Subtitle D of RCRA and the Clean Water and Safe Drinking Water Acts;

2. Working with the States to encourage changes in their regulations and enforcement programs to achieve more uniformity in the administration of their programs; and

3. Working with Congress to develop any additional statutory authority that may be required.

A. Federal Program Improvements Within Existing Authorities

1. Clean Water and Safe Drinking Water Act Programs

The Agency believes certain improvements in the Safe Drinking Water and Clean Water Acts are desirable with respect to their application to crude oil and natural gas wastes. In the case of the UIC program, the Agency had previously determined that a critical examination of the overall program was in order. The program has now been in effect for approximately 5 years or more, depending on when a State program was approved or a Federal program was promulgated in a State. This examination, currently underway, includes a review of the adequacy of the regulations and policies governing the program and of

the way in which States and EPA Regions are implementing and enforcing the program. The review of the adequacy of State implementation is complex because approval of State programs was, by statute, governed by a determination of their effectiveness in protecting underground sources of drinking water, rather than by their conformity with minimum Federal regulations.

Implementation of the UIC program by the EPA Regions is undergoing a peer review process, which will be completed by the fall of 1988. Implementation of the State programs is reviewed

routinely by the EPA Regions. In addition, the EPA's Office of Drinking Water has undertaken a cycle of in-depth reviews of the UIC program. The California, Texas, and Kansas programs were **[Page 25457]** reviewed in 1987. A review of Wyoming and at least one other State, not yet selected, will be conducted in 1988. The States have also undertaken a peer review project directed by the Underground Injection Practices Council.

The Agency has formed a workgroup, which will include participation by the States and other Federal agencies, to review issues pertinent to the UIC regulations. The stategy for this review is available in the RCRA docket. A final report and the recommendations of the workgroup are expected to be available in the winter of 1988-89.

In conjunction with the Clean Water Act, the Agency is currently developing national discharge regulations for the offshore crude oil and natural gas industry and is planning for the development of national discharge regulations for the coastal oil and gas industry. The coastal segment generally includes exploration, development and production facilities that are located in or adjacent to tidal wetlands. These regulations will cover the discharges of produced water, drilling fluids, drill cuttings and various low-income waste streams to surface waters of the U.S. The regulations will address the best available technology (BAT), best conventional technology (BCT) and new source performance standards (NSPS) levels of control. These regulations may result in a prohibition on the discharge of a significant portion of high volume drilling wastes (drilling fluids and cuttings) into U.S. offshore waters. As such, these wastes will be transported to shore by the offshore operators for land disposal. These wastes would then be subject to regulation under RCRA Subtitle D.

The Agency is also planning to begin development of national effluent regulations for onshore stripper oil and gas production. The onshore stripper well regulations will cover the discharges of produced water and well treatment wastes to surface waters of the U.S. These regulations will be established at increasing levels of stringency compared to the best practicable technology (BPT) level of control. Non-stripper wells located onshore are already subject to a "zero-discharge" requirement under NPDES.

22. RCRA Subtitle D Approach

(a) General Approach. EPA believes it can design and implement a program specific to crude oil and natural gas wastes under Subtitle D of RCRA that effectively addresses the risks associated with these wastes. EPA is already in the process of developing revised Subtitle D criteria for facilities that may receive hazardous household waste or small quantity generator hazardous wastes as well as for mining waste disposal facilities.
53 FR 25457

The Agency intends to augment the Subtitle D program by developing appropriate standards and taking other actions as appropriate for crude oil and natural gas wastes.

In developing these tailored Subtitle D standards for crude oil and natural gas wastes, EPA will focus on gaps in existing State and Federal regulations and develop appropriate standards that are protective of human health and the environment. Gaps in existing programs include adequate controls specific to associated wastes and certain management practices and facilities for large-volume wastes, including roadspreading, landspreading, and impoundments. EPA is particularly concerned about centralized and commercial facilities that treat, store, or dispose of oil field wastes in concentrated form. Pits or impoundments at these facilities often contain hazardous constituents in high concentrations. In addition, centralized facilities are responsible for some of the most significant damages the Agency documented.

To ensure proper control over oil and gas disposal facilities and practices, EPA will consider requirements under Subtitle D such as: (1) Engineering and operating practices, including run-off controls, to minimize releases to surface water and groundwater; (2) proper procedures for closing facilities; (3) monitoring that accommodates site-specific variability; and (4) clean-up provisions. EPA will tailor these standards to the special problems posed by oil and gas waste disposal facilities, as well as incorporate appropriate flexibility to address site-specific variability.

In developing a tailored Subtitle D program for oil and gas wastes, EPA will use its RCRA section 3007 authority to collect any additional information needed on the characteristics and management practices of oil and gas wastes. EPA believes this authority does not limit information collection to "hazardous" waste identified under Subtitle C, but also authorizes the collection of information on any solid waste that the Agency reasonably believes may pose a hazard when improperly managed. (EPA may also use this authority in preparing enforcement actions.)

In specifying the appropriate standards, EPA also will further analyze existing Federal and State authorities and programs and determine future plans for administering their oil and gas waste programs. Additionally, EPA will perform analyses of costs, impacts,

and benefits and will comply fully with Executive Orders 12291 and 12498, the Regulatory Flexibility Act, and the Paperwork Reduction Act.

The Agency will specifically consider the impact of future regulations on small business operations in the process of regulatory development under the Agency guidelines with respect

to the Regulatory Flexibility Act. The Agency believes that the tailored RCRA Subtitle D regulations can provide the flexibility necessary to reflect the marginal economic nature of certain segments of the industry, while at the same time affording improved environmental protection. For example, the Agency recognizes that many stripper operations are, by their nature, more vulnerable to regulatory burdens imposed by any new controls over crude oil and natural gas wastes, and that many stripper wells are associated with small, non-integrated producers. This is particularly significant in certain producing regions such as Appalachia.

(b) Alaska's North Slope. Tailored standards under Subtitle D will specifically address controls necessary to protect fragile or sensitive environments; one such sensitive environment is the Arctic North Slope. EPA is particularly concerned about the management of crude oil and natural gas wastes in this area, where oil extraction is performed on a very large scale, accounting for roughly 20 percent of total U.S. production. There also exists the likelihood for future development of potentially significant crude oil and natural gas reserves on the North Slope in areas surrounding Prudhoe Bay and areas in the Arctic National Wildlife Refuge.

The Arctic North Slope is particularly sensitive and fragile, with unique geographic and climatic conditions that make its environment fundamentally different from the lower 48 States. The area is primarily an arctic desert, frozen for about 9 months out of the year and underlain by up to 2,000 feet of permafrost. During the summer months, surface water exists in the form of interconnected tundra ponds, which exhibit little or no flow during the summer season. This, in addition to the severity of the climate and the shortness of the growing season, makes the area particularly vulnerable to ecological impacts, or impacts from less than rigorous waste management practices.

There is a lack of long-term historical data on impacts of crude oil and natural gas industry activities on the North Slope. Based on preliminary studies, **[Page 25458]** current waste management practices used on the North Slope pose the potential for environmental degradation. As stated in the Report to Congress, a 1983 U.S. Fish and Wildlife Service study found chromium, arsenic, cadmium, nickel, and barium to be present in tundra ponds adjacent to reserve pits at levels significantly greater than in control ponds. Levels of chromium in

adjacent ponds were also found to exceed EPA chronic toxicity criteria, and affected distant ponds were found to contain chromium levels significantly higher than background levels. The authors of this study caution, however, that these findings cannot be extrapolated to present-day oil field practices on the North Slope because some industry practices have changed and the State's regulations have become increasingly more stringent since

1983.

Historically, enforcement of environmental controls on the North Slope has been inadequate. EPA believes this inadequacy has contributed to the use of undesirable waste management practices in some cases. For example, as discussed in the Report to Congress, an incident developed involving an oil field service company that was disposing of drums and waste chemicals in an inappropriate manner. The Agency believes that a greater enforcement presence in addition to improved regulations could prevent such incidents from recurring.

Recently, the State of Alaska has improved waste management regulations pertaining to the North Slope. In addition, some operators plan to implement more desirable waste management practices, including the possibility of phasing out reserve pits through the use of closed drilling systems and injection for waste drilling muds and cuttings. If implemented, these changes would be major improvements in waste management practices on the North Slope.

B. Additional Federal Authorities

EPA is concerned over the lack of Federal authority under Subtitle D of RCRA to address treatment and transportation of oil and gas wastes. The Administrator therefore will work with Congress to develop any additional legislative authorities that may be needed to address these issues. In the interim, EPA will use section 7003 of RCRA and sections 104 and 106 of CERCLA to seek relief in those cases where wastes from oil and gas sites pose substantial threats or imminent hazards to human health and the environment. Oil and gas waste problems can also be addressed under RCRA section 7002 which authorizes citizen lawsuits for violations of Subtitle D requirements in 40 CFR Part 257.

C. Improvement in State Programs

While in the process of completing improvements in the Federal programs, EPA plans to work with the States to improve the content, implementation, and enforcement of existing State regulations. This will be a cooperative effort with voluntary State participation. For example, the Interstate Oil Compact
Commission has already begun work in this area and has expressed an interest in cooperating with EPA in this regard. Specifically, the Agency plans to encourage States to take steps to fill the following

gaps (where present) in their existing regulatory programs:

(1) Controls for roadspreading and landspreading;

(2) Surface impoundment (i.e., pit) location, design, and maintenance;

(3) Controls for associated wastes; and

(4) Plugging abandoned oil and gas wells.

According to State officials, many States have tens of thousands of unplugged or improperly plugged abandoned wells. EPA's December 1987 Report to Congress documented ground-water contamination with chlorides from unplugged or improperly plugged abandoned crude oil and natural gas wells and indicated that State requirements for plugging and abandoning crude oil and natural gas wells vary, with inadequacies apparent in some State programs. For example, many States do not require a plugging bond from operators who drill crude oil and natural gas wells. Where bonding is required, the amount is often not adequate to provide for proper plugging once a well is abandoned.

EPA encourages States to develop programs to address abandoned wells. However, the Agency recognizes that locating and identifying these wells is difficult, and sometimes impossible, because of poor record keeping or the absence of records. Because many unplugged wells are several decades old, the owner or operator often cannot be identified. Some States have plugging funds to use in such circumstances, some do not.

The Agency will also work with States to improve implementation and enforcement of existing State regulations. EPA believes that improvements in enforcement of existing regulations will significantly increase protection of human health and the environment.

EPA will also work closely with the State of Alaska on addressing problems associated with management of crude oil and natural gas wastes on the Arctic North Slope. Because of the remoteness and severe climatic conditions, enforcement is particularly difficult in this area. The Agency will explore with the State of Alaska and the Department of the Interior ways to improve enforcement in this area. The Agency believes operators should continue research into impacts on the environment of their waste management practices. The Agency will develop a list of recommended areas for research in the research, demonstration, and development plan required by RCRA section 8002(m)(2).

VI. Regulatory Determination for Geothermal Energy Wastes

A. Hazard Assessment

There is only a limited record of damages or danger to human

health or the environment resulting from the exploration, development, and production of geothermal energy. Based on the limited information available, the Agency has determined that the risk to human health and the environment resulting from the exploration, development, and production of geothermal energy is relatively low. The geothermal energy industry is comparatively small, with a total of 395 wildcat, production, and injection wells drilled between 1981 and 1985. Most geothermal energy production is in California (321 out of 395 wells) and Nevada. It is unlikely that there will be further large-scale development of geothermal energy resources outside of the State of California because the occurrence of accessible geothermal energy is extremely limited.

B. Adequacy of State and Federal Regulations

As indicated in the Report to Congress, the Agency believes that existing State and Federal regulations are generally adequate for controlling wastes from geothermal energy production. However, one public comment on the Report to Congress suggests a possible gap in California's regulatory program addressing these wastes. The commenter documented potential endangerment of human health and damage to the environment because of the disposal of geothermal energy hydrogen sulfide abatement wastes in commercial facilities in California.

C. Conclusions

EPA has decided not to regulate wastes generated by the exploration and development of geothermal energy resources under RCRA Subtitle C. EPA believes that Subtitle C control for these **[Page 25459]** wastes is unwarranted because of the relatively low risk of these wastes and the presence of generally effective State and Federal regulatory programs. Because these wastes are largely confined to California and Nevada, EPA will work closely with these States to address any gaps in their regulatory programs for the management of hydrogen sulfide abatement wastes.

VII. Research, Development, and Demonstration Plan

The Agency will develop a research, development, and demonstration plan based on the findings of the Report to Congress and subsequent public comments on the report. This plan will outline various topics that the Federal and State governments and/or industry could pursue.

This plan will include the following topics:

-- Alternative waste management technologies;

-- Waste minimization techniques;

-- Materials substitution;

-- Recycling and reuse;

-- Reserve pit construction (percolation, leaching, and erosion control issues);

-- Plugging and abandonment of crude oil and natural gas wells;

-- Better characterization of produced waters and associated wastes generated by stripper crude oil and natural gas wells; and

-- Field monitoring to evaluate the adequacy of waste containment practices.

VIII. EPA RCRA Docket

The EPA RCRA docket is located at:

United States Environmental Protection Agency, EPA RCRA Docket (Sub-basement), 401 M Street, SW., Washington, DC 20460.

The docket is open from 9:30 a.m. to 3:30 p.m., Monday through Friday, except for Federal holidays. The public must make an appointment to review docket materials. Call the docket clerk at (202) 475-9327 for appointments.

The following documents related to this regulatory determination are available for inspection in the docket:

-- Report to Congress on Management of Wastes from the Exploration, Development, and Production of Crude Oil, Natural Gas, and Geothermal Energy;

-- All supporting documentation for the regulatory determination, including public comments on the Report to Congress and EPA response to comments; and

-- Transcripts from the public hearings on the Report to Congress.

Dated: June 29, 1988.

A. James Barnes,

Acting Administrator.

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